

room temperature for 15 minutes, followed by hot air drying for 15 minutes, and finally dried at 120° C. overnight. The catalyst was calcined, reduced, and then activated before use or testing as earlier described for batch testing.

Catalyst 4 (5 wt % Pt and 0.5 wt % Ge on C):

A 5% Pt/0.5% Ge catalyst was prepared using a previously prepared 5% Pt on an engineered Hyperion carbon support. A solution of GeCl_4 in an amount sufficient to give 0.5 wt % Ge on the catalyst was prepared in anhydrous ethanol of sufficient volume to reach incipient wetness of the catalyst support. The ethanolic GeCl_4 solution was added to the catalyst until the incipient wetness point of the catalyst was reached. The catalyst was then dried in an oven set to 120° C. A sample of the dried catalyst was calcined and reduced as previously described for batch testing. Prior to use the catalyst was activated as described for batch testing.

Catalyst 5 (5 wt % Pt and 0.5 wt % Sn on C):

A 5% Pt/0.5% Sn catalyst was prepared using a previously prepared 5% Pt on an engineered Hyperion carbon support. A solution of $\text{SnCl}_4 \cdot 2\text{H}_2\text{O}$ in an amount sufficient to give 0.5 wt % Sn on the catalyst was prepared with a sufficient amount of 6M HCl to prevent precipitation. The impregnation solution was then diluted with HCl (2-6M) to a volume such that upon addition of the solution the incipient wetness point of the catalyst was reached. The catalyst was then dried in an oven set to 120° C. A sample of the catalyst was calcined and reduced under the same conditions as described for the batch testing. Prior to use the catalyst was activated as previously described for batch testing.

Catalyst Analysis:

Catalyst 1 was evaluated for its ability to decarboxylate oleic acid as well as a linoleic acid/oleic acid mixture in Run 8. An up-flow reactor with a nominal volume of 6 cm³ was packed with 2.90 g of Catalyst 1. For this experiment, the temperature was monitored by a thermocouple placed into the aluminum block encompassing the reactor tube. Additionally, the temperature of an aluminum block encompassing the feed pre-heater was also monitored. The pre-heater block and reactor block were brought to an initial temperature of 260° C. and 328° C., respectively. The column was purged with 2.5 mL/min of N_2 before beginning the oleic acid feed. The N_2 remained on at 2.5 mL/min for the duration of the experiment. The initial WHSV was 2.0 hr⁻¹. Samples 1 and 2 were then taken, each with a collection time of 3 hr. The WHSV was then decreased to 1.7 hr⁻¹. Sample 3 was drawn after a collection time of 12 hr. Next, the pre-heater block temperature was decreased to 54° C. and the reactor block temperature was increased to 352° C. Samples 4-7 were subsequently collected with collection times ranging from 4 to 17 hrs. After Sample 7 was collected, the WHSV was decreased to 1.4 hr⁻¹. Samples 8-10 were then collected with collection times ranging from 6 to 17 hr. After Sample 10 was collected, the reactor block temperature was increased to 372° C. Samples 11-19 were then collected, with collection times ranging from 5 to 15 hr. The pre-heater block temperature was then increased from 62° C. to 75° C. Sample 20 was collected after 8 hr. The WHSV was then decreased to 1.0 hr⁻¹. Sample 21 was collected after 19 hr. The pre-heater block temperature was then increased to 75° C. Sample 22 was drawn after 26 hr. The pre-heater block temperature was then decreased to 70° C. Samples 23 through 31 were drawn with collection times ranging from 22 to 26 hr. At the beginning of the collection of Sample 32, linoleic acid was added to the oleic acid feed such that the nominal composition of the feed was 50/50 by weight. Sample 32 was then collected after 24 hr. Samples 1-32 were analyzed via GC with a derivatization method

similar to that in Example 1. Additionally, the gas phase effluent from the reactor was analyzed with GC.

The results of Run 8 are presented in FIGS. 30 and 31 as well as Table 8. As shown in FIGS. 30a-b, a large yield of "Others" was observed in the liquid products. The "Others" category includes, but is not limited to, cracking products, aromatics and branched products of the oleic acid feed. FIGS. 30a-b also show that decreasing the WHSV and pre-heater block temperature and increasing the reactor block temperature resulted in a higher yield of deoxygenated products as well as greater conversion of oleic acid. The results for Sample 32 in FIG. 30a reveal that all of the linoleic acid fed was converted. FIG. 31 gives the combined level of decarboxylation and decarbonylation since CO and CO₂ were observed as major gaseous products. FIG. 31 reveals that the combined level of decarboxylation and decarbonylation remained reasonably steady between approximately 300 and 500 hr time-on-stream. Table 7 reveals the average gas composition of Samples 26-31.

TABLE 8

Reactor Gas Effluent Concentrations, vol %		
Feed	Oleic Acid	50/50 Oleic Acid/Linoleic Acid
Sample Number	26-31*	32
H ₂	14	13
CO	22	22
CO ₂	20	19
N ₂	42	42
Light Alkanes	2	4

*The average concentrations of the samples.

In view of the many possible embodiments to which the principles of the disclosed invention may be applied, it should be recognized that the illustrated embodiments are only preferred examples of the invention and should not be taken as limiting the scope of the invention. Rather, the scope of the invention is defined by the following claims. We therefore claim as our invention all that comes within the scope and spirit of these claims.

We claim:

1. A method, comprising:

providing a catalyst comprising platinum that is combined with a non-transition metal to facilitate dehydrogenation;

exposing a composition comprising fatty acids to the catalyst; and

dehydrogenating at least 10% of the fatty acids with the catalyst to produce a product comprising branched, cyclic, and/or aromatic compounds.

2. The method of claim 1 wherein at least a portion of the fatty acids are unsaturated fatty acids, and dehydrogenating further comprises transfer hydrogenation.

3. The method of claim 1 wherein the catalyst deoxygenates at least 10% of the product.

4. The method of claim 3 wherein the product further comprises deoxygenated hydrocarbons, and at least a portion of the deoxygenated hydrocarbons are cyclic and/or aromatic.

5. The method of claim 1 wherein the non-transition metal is Ge, Sn, or a combination thereof.

6. The method of claim 1 wherein the catalyst further comprises Pt/Ge on carbon, Pt/Sn on carbon, or a combination thereof.

7. The method of claim 6 wherein the catalyst further comprises 1 wt % to 5 wt % Pt, and 0.1 wt % to 5 wt % Ge, Sn, or a combination of Ge and Sn, relative to a mass of the catalyst.